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EXAMINER

KIELIN, ERIK J

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 01/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/583,386

Applicant(s)

CARLEY, L. RICHARD

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 15 November 2004.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1,3,4,21,22,24 and 26-33 is/are pending in the application.
- 4a) Of the above claim(s) 27-33 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3,21,22,24 and 26 is/are rejected.
- 7) ☒ Claim(s) 4 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### DETAILED ACTION

This action responds to the submissions filed 10/7/2004 and 11/15/2004.

#### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 3, 21, 22, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art, US 5,493,177 (**Muller et al.**) in view of US 6,441,451 B1 (**Ikeda et al.**).

Regarding claim 1, **Muller** discloses a method of fabricating a microstructure in a sealed cavity comprising,

providing a substrate **38** having a substantially planar support surface (Figs. 8A-1, 8A-2);

depositing a first layer of sacrificial material **176, 177** over said planar support surface (Figs. 8B-1, 8B-2, 8C-1, 8C-2);

depositing an etchable layer of structural material **180** over said first layer of sacrificial material **176, 177** (Figs. 8D-1, 8D-2);

forming a microstructure **24, 28, 116** on said support surface by etching said layer of structural material, said microstructure contacting said substrate at an anchor point (Figs. 8E-1, 8E-2);

depositing a second layer of sacrificial material **184** over said microstructure **24, 28, 116** (Figs. 8G-1, 8G-2);

depositing a cap **186** over said second layer of sacrificial material **184**, said cap **40** layer extending from points on said support surface, whereby said cap layer and said support surface define a capsule about and interior region containing said microstructure and said first and second sacrificial layers (Figs. 8H-1, 8H-2);

forming one or more holes **32, 34** (called "ETCHING CHANNEL") in said cap layer **186**, said holes being restricted to an area of said sealed cavity not directly above said microstructure (Fig. 8I-2);

introducing an etchant into said interior region through said one or more holes **32, 34**, wherein said sacrificial material **184** is chosen to have a high etch rate differential with respect to said structural material, so that said etchant removes said first and second sacrificial layers **176, 177, 184** while leaving said microstructure **24, 28, 116** and said substrate **38** substantially intact, thereby releasing said microstructure **24, 28, 116** as a **movable structure (col. 6, lines 1-54)** secured at said anchor point to said substrate (Figs. 8J-1, 8J-2); and

sealing said one or more holes **32, 34** in said cap layer with a seal layer **190**, thereby forming a sealed cavity that encapsulates said movable microstructure, said sealed cavity being defined by said seal layer **190** and said planar support surface **178** (Figs. 8K-1, 8K-2).

**Muller** does not teach using dry plasma to remove the sacrificial material.

**Ikeda** teaches the benefits of using dry plasma etching to remove a sacrificial material **140** through an etching channel **90** to prevent breakage of the microstructure due to surface tension created by liquid etchants, such as the liquid etchant used in **Muller**. (See **Ikeda**, col. 7,

lines 12-24, lines 30-35, and especially lines 56-61 and col. 8, lines 58-59; Figs. 1(a)-1(h), Figs. 4(a)-4(h).)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use dry plasma to etch the sacrificial material of **Muller**, to prevent breakage of the microstructure, as taught by **Ikeda** (col. 7, lines 56-61).

Regarding claim 3, **Muller** discloses that the substrate is silicon and has a layer of silicon nitride 178 deposited thereon (Figs. 8A-1, 8A-2).

Regarding claim 21, **Muller** discloses and **Ikeda** teaches that the etchant used to remove the sacrificial layer is specifically selected to have a high etch rate with respect to the sacrificial material and the substrate and cap layers in order to remove only the sacrificial layer, as shown in the Figs. of both Muller and Ikeda. Formation of microstructures could not occur in the absence of such etch selectivity.

Regarding claim 22, **Muller** discloses and **Ikeda** teaches that the structural material is resistant to the etchant.

Regarding claim 26, **Muller** discloses that the holes are etched into said cap layer so as to establish communication with said first and second layers of sacrificial material. (Fig. 8I-2).

3. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Muller** in view of **Ikeda** as applied to claim 1 above, and further in view of US 5,573,679 (**Mitchell et al.**).

The prior art of **Muller** in view of **Ikeda**, as explained above, discloses each of the claimed features except for teaching that the etchant is introduced by a barrel etcher. However, it has been held that to be entitled to weight in method claims, the recited structure limitations

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therein must affect the method in a manipulative sense, and not amount to the mere claiming of a use of a particular structure. Ex parte Pfeiffer, 1962, C.D. 408 (1961). In the instant case, it does not matter how the etchant is introduced so long as it is a “non-liquid” to meet the criteria established by Applicant to meet the inventive value of eliminating a liquid etchant.

If it is thought however that the barrel etcher has patentable weight, then this may be a difference. But **Mitchell** teaches a method of removing sacrificial material **24** through holes **34** (Fig. 2D) using a “fluorine-containing” species introduced by a barrel etcher (called “barrel reactor” therein; col. 4, lines 1-13).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to introduce the dry plasma etchant of **Ikeda** to remove the sacrificial material of **Muller** using a barrel etcher, because **Ikeda** is silent to the method of introducing the plasma etchant, such that one of ordinary skill would be motivated to seek out an apparatus for carrying out the etching, such as the one in **Mitchell** since the processes are similar for introducing fluorine-containing etchants which are “non-liquid” into holes to isotropically remove sacrificial material. Furthermore, Applicant has not indicated that the apparatus by which the “non-liquid etchant” is introduced is somehow critical or manipulative of the method.

4. Claims 1, 3, 21, 22, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,798,283 (**Montegue et al.**) in view of and **Ikeda**.

Regarding claim 1, **Montegue** discloses a method of fabricating a microstructure in a sealed cavity comprising,

providing a substrate **14** having a substantially planar support surface (Figs. 2, 3);

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depositing a first layer of sacrificial material **30** over said planar support surface (Figs. 4);

depositing an etchable layer of structural material **26** over said first layer of sacrificial material **30** (Figs. 4);

forming a microstructure **26** on said support surface by etching said layer of structural material composed of a structural material **18** on said substrate, said microstructure being secured to said substrate by a first layer of sacrificial material **48** (Fig. 4);

depositing a second layer of sacrificial material **32** over said microstructure **26** (Figs. 5);

forming a cap **34** on said second layer of sacrificial material **32**, said cap **34** layer extending from points on said support surface, whereby said cap layer and said support surface define a capsule about and interior region containing said microstructure **26** and said first and second sacrificial layers **30**, **32** (Figs. 8);

forming one or more holes **48** in said cap layer **34**; (Fig. 11);

introducing an etchant into said interior region through said one or more holes, wherein said sacrificial material is chosen to have a high etch rate differential with respect to said structural material, so that said etchant removes said first and second sacrificial layers while leaving said microstructure and said substrate substantially intact, thereby releasing said microstructure as a **movable structure** (col. 6, lines 13-17) secured at said anchor point to said substrate (Fig. 12); and

sealing said one or more holes in said cap layer **34** with a seal layer **50**, thereby forming a sealed cavity that encapsulates said movable microstructure, said sealed cavity being defined by said seal layer and said planar support surface (Fig. 13).

**Montegue** does not teach using dry plasma to remove the sacrificial material.

**Ikeda** teaches the benefits of using dry plasma etching to remove a sacrificial material 140 through an etching channel 90 to prevent breakage of the microstructure due to surface tension created by liquid etchants, such as the liquid etchant used in **Montegue**. (See **Ikeda**, col. 7, lines 12-24, lines 30-35, and especially lines 56-61 and col. 8, lines 58-59; Figs. 1(a)-1(h), Figs. 4(a)-4(h).)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use dry plasma to etch the sacrificial material of **Montegue**, to prevent breakage of the microstructure, as taught by **Ikeda** (col. 7, lines 56-61).

Regarding claim 3, **Montegue** discloses that the substrate **14** is silicon and has a layer of silicon nitride **22** deposited thereon (Figs. 3).

Regarding claim 21, **Montegue** discloses and **Ikeda** teaches that the etchant used to remove the sacrificial layer is specifically selected to have a high etch rate with respect to the sacrificial material and the substrate and cap layers in order to remove only the sacrificial layer, as shown in the figures of both **Montegue** and **Ikeda**. Formation of microstructures could not occur in the absence of such etch selectivity.

Regarding claim 22, **Montegue** discloses and **Ikeda** teaches that the structural material is resistant to the etchant.

Regarding claim 26, **Montegue** discloses that the holes are.



*Allowable Subject Matter*

5. Claim 4 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. The following is a statement of reasons for the indication of allowable subject matter:

The reference of Yao (US 5,578,976) teaches a method of forming a MEMS comprising providing a substrate **12**, sacrificial layers of photoresist **30, 38** (called “polyimide” in Yao; Figs 5A-6E) which secure the MEMS to the substrate until etched away, and structural material of aluminum **22, 24**. Yao also discloses that it is especially beneficial to use a barrel etcher with an oxygen plasma to remove the sacrificial layers in order to circumvent problems associated with surface tension created by wet etching. (See Yao, col. 5, lines 41-65 and especially col. 6, lines 6-13.) Note that the instant specification indicates the objective of the instant invention is to overcome the problems of surface tension by using a “non-liquid etchant” for at least the removal of the last sacrificial layer (specification, p. 3, lines 10-24.)

Yao fails to teach that the microstructure is sealed prior to etching to remove the sacrificial material. Accordingly, it would be at best obvious to try combining the teaching of Yao with either of Muller or Montegue, given the potential uncertainty of the ability of a dry oxygen plasma to remove the photoresist using etching holes in a cap layer, as argued by Applicant in the affidavit filed 23 September 2002 --**specifically along with all of the specifically claimed features.**

Accordingly, the prior art does not teach or suggest, in combination with the other claimed limitations, the use of aluminum as the structural material, photoresist as the sacrificial material and oxygen plasma as the etchant.

### *Response to Arguments*

7. Applicant's arguments filed 10/7/2004 have been fully considered but they are not persuasive.

Applicant argues that Muller in view of Ikeda fails to teach the instant invention. Examiner respectfully disagrees. Applicant argues that the Muller uses a wet etchant rather than a dry plasma etchant and that the use of such etchant amounts to a teaching away. Examiner respectfully submits Applicant apparently has no clue as to what a teaching away is. Examiner respectfully submits that the absence of a teaching is NOT a teaching away.

It has been held,

“The use of patents as references is not limited to what the patentees describe as their own inventions or to the problems with which they are concerned. They are part of the literature of the art, relevant for all they contain.” *In re Heck*, 699 F.2d 1331, 1332-33, 216 USPQ 1038, 1039 (Fed. Cir. 1983) (quoting *In re Lemelson*, 397 F.2d 1006, 1009, 158 USPQ 275, 277 (CCPA 1968)). A reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill the art, **including nonpreferred embodiments**. *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989). See also *Celeritas Technologies Ltd. v. Rockwell International Corp.*, 150 F.3d 1354, 1361, 47 USPQ2d 1516, 1522-23 (Fed. Cir. 1998) (The court held that the prior art anticipated the claims even though it taught away from the claimed invention. “The fact that a modem with a single carrier data signal is shown to be less than optimal does not vitiate the fact that it is disclosed.”). **Disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or non-preferred embodiments**. *In re Susi*, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). “A known or obvious

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composition does not become patentable **simply because it has been described as somewhat inferior to some other product for the same use.**" *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994).

With this in mind, because the rejection is over Muller in view of Ikeda and because Ikeda states that dry etchants are better than wet etchants to prevent sticking due to surface tension which may break the fragile parts of a MEMS (Ikeda, col. 7, lines 56-61), one of ordinary skill in the art has the expressed teaching to use a dry oxygen plasma etchant of Ikeda (Ikeda col. 6, lines 56-60) that is introduced into a hole in a cap layer to remove a sacrificial layer as the etching method to remove the sacrificial layer in the Muller method, to prevent surface tension its the associated problems. Accordingly, the argument is not persuasive.

Applicant further argues that Ikeda does not teach that the cavity is defined by the planar support surface and the cap layer. Examiner respectfully disagrees. The support surface of the MEMS made of protective film 178 on substrate 38 is in fact planar (Muller Figs. 8J1 and 8J2). The cap layer 186 (same Figs.) above the support surface 178, 38 sealed to the planar support surface **defines** the cavity. It appears the Applicant is suggesting that the support surface is planar everywhere. The support surface is taken to be that portion of the surface actually supporting the MEMS --not everything else surrounding it. First this limitation is not required in the claims, and it is well established that limitations from the drawings will not be imported into the claims. Second, assuming *arguendo*, that the claims somehow limited the "planar support surface," it would still not make the instant claims patentable or enforceable. The instant invention is predicated on using a dry etchant, not on the topography of the substrate. There exists no evidence of record to show that surface topography has anything at all to do at all with

making the use of a dry plasma etchant to remove a sacrificial layer between a MEMS support surface and a cap layer, novel and non-obvious.

Applicant's argument regarding "cap" and "seal" layers is wholly without merit.

Examiner respectfully suggests Applicant compare Applicant's Fig. 8B (18 cap layer, 26 seal layer) with Fig. 8K-2 of Muller (186 cap layer, 190 seal layer). Each shows a cap layer beneath the seal layer. So to every extent that Applicant presently argues that the "seal layer" defines the cavity, Applicant is necessarily arguing that Muller teaches this because the configuration is exactly the same between the seal and cap layers in the instant drawings and in Muller.

Accordingly, Applicant argument is contradictory to that shown in Applicant's own drawings.

Applicant's arguments of that lacking in Ikeda is irrelevant because Muller teaches these things. For example, Ikeda is not required to teach holes in a cap layer though which etchant is fed because Muller discloses this. Nonetheless, Ikeda does, in fact, teach this. Ikeda states,

"The sacrificial layer 140 is removed, as shown in FIG. 1(g), isotropically in the **dry etching by injecting gasses** whose main component is **oxygen** excited by **plasma** into the **hole 190**, thereby forming the **cavity 141** between the first insulating layer 120 and the first diaphragm layer 150." (Emphasis added.)

Note that the diaphragm layer is a cap layer until it actually functions as a diaphragm. One of ordinary skill very clearly gets the idea that dry etching using an oxygen plasma works better than a wet etchant to remove sacrificial layers in a cavity to prevent surface tension --as expressly suggested in Ikeda. Because both Muller and Ikeda teach feeding etchant into a cavity through a hole, to form a MEMS device, they are drawn --very closely-- to the same endeavor in this regard and, accordingly, one of ordinary skill has a very reasonable expectation of success.

Similarly, Applicant argues the Ikeda does not teach the seal layer or a sealed cavity. This is irrelevant because Muller teaches this. By this argument, Applicant would suggest that the only teaching must be complete anticipation by a single reference, but 35 USC 103(a) says not so. All that Ikeda need do is fill the deficiency and the combination must be proper. For reasons of record, Examiner respectfully submits that the rejection is proper and all features presently claimed in the rejected claims are taught by the applied art of Muller and Ikeda.

Applicant's attempts to create a teaching away in Ikeda. Simply because Ikeda does not use the terminology that Applicant used does not negative that it taught in Ikeda, nor does an allegedly not taught thing constitute a teaching away. The absence of a teaching is not a teaching away --much less the alleged absence of a feature, very clearly present. Ikeda is **very much in favor of feeding a dry oxygen plasma through holes in a "cap layer"** which is only later used as a diaphragm in a MEMS device.

Applicant suggests that the combination of Muller with Ikeda is improper because it would destroy the principle of operation of Muller and that there is no suggestion or motivation to combine the references. Examiner respectfully but emphatically disagrees for reasons already of record.

The remainder of Applicant's arguments regarding the rejection of the claims over Muller in view of Ikeda and further in view of other references are premised upon alleged deficiencies in Muller and Ikeda. For reasons of record, Muller and Ikeda are not deficient, and Applicant's arguments, therefore, persuasive.

Applicant argues that Montague does not form the sacrificial layer, structural layers, and cap layers on the surface of the **substrate**, but this is very clearly shown in the Montague Figs. to

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every extent presently claimed. Simply because a portion of the substrate in Montegue is etched away prior to forming the MEMS structure, does not change the fact that the etched portion is still the upper surface of the substrate. Moreover, note that, as presently claimed, the term “substrate” is **not** used in the claims; rather, the term “support surface” is used. This is not surprising since there is absolutely **no direct contact with the substrate of any feature of the sacrificial materials, the structural material, or the cap materials in the instant specification. (See the instant figures.)** Instead, CMOS circuitry and a protective silicon nitride layer intervene. Accordingly, there exists no support in the specification for direct contact between any of the layers and the substrate. Even though this is not presently claimed, it would only invite a 35 USC 112(1), new matter rejection.

Finally it is noted, in response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Accordingly, the arguments are not persuasive.

### *Conclusion*

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after

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the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 571-272-1693. The examiner can normally be reached from 9:00 - 19:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Erik Kielin  
Primary Examiner  
January 23, 2005